Space Based Weather

Business of Space **Space Operations Scho**
5 Dec 2001

Overview

- Space Based Weather Collection Overview
- Geostationary Weather Satellites
- Polar Orbiting Weather Satellites
- Ground Systems and Communications

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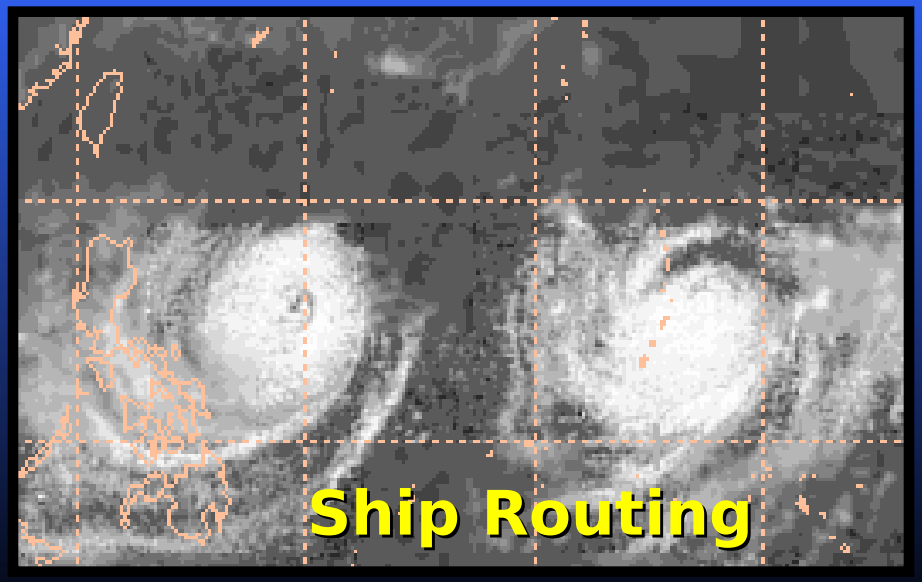
Military Uses of Satellite Weather Data

Resource Protection

Operation Timing

Compute Flight Plans

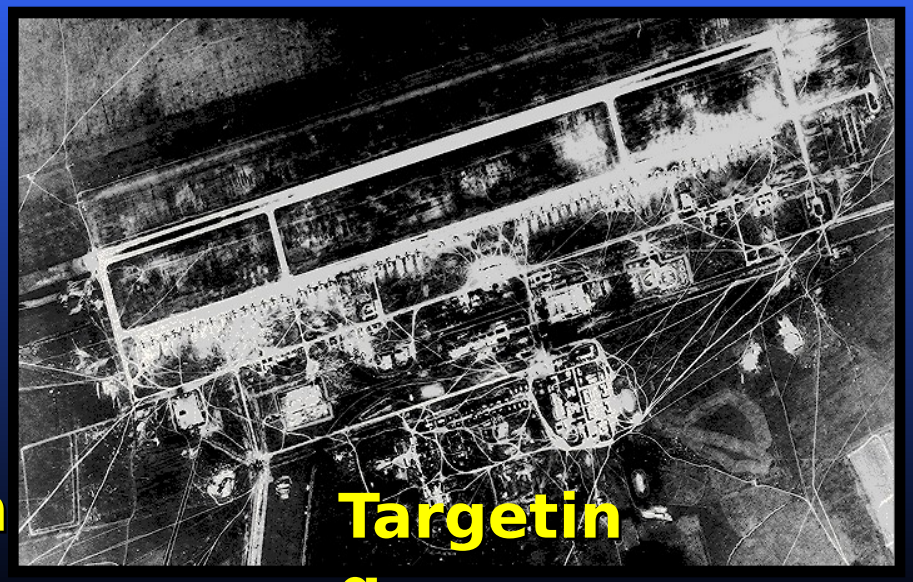

Ship Routing

Military Uses of Satellite Weather Data

Munitions Selection

Chemical Weapon Dispersio

Radar and Comm Problem



Targetin
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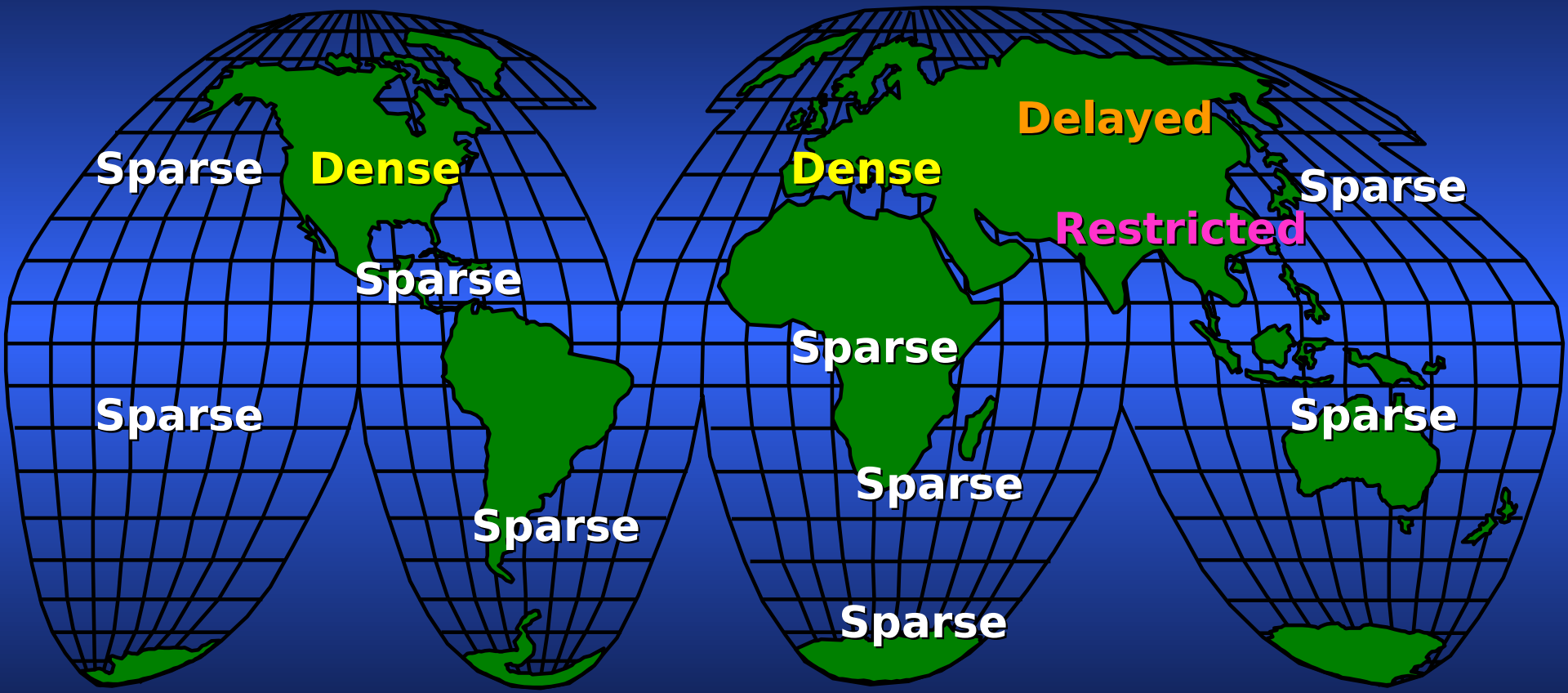
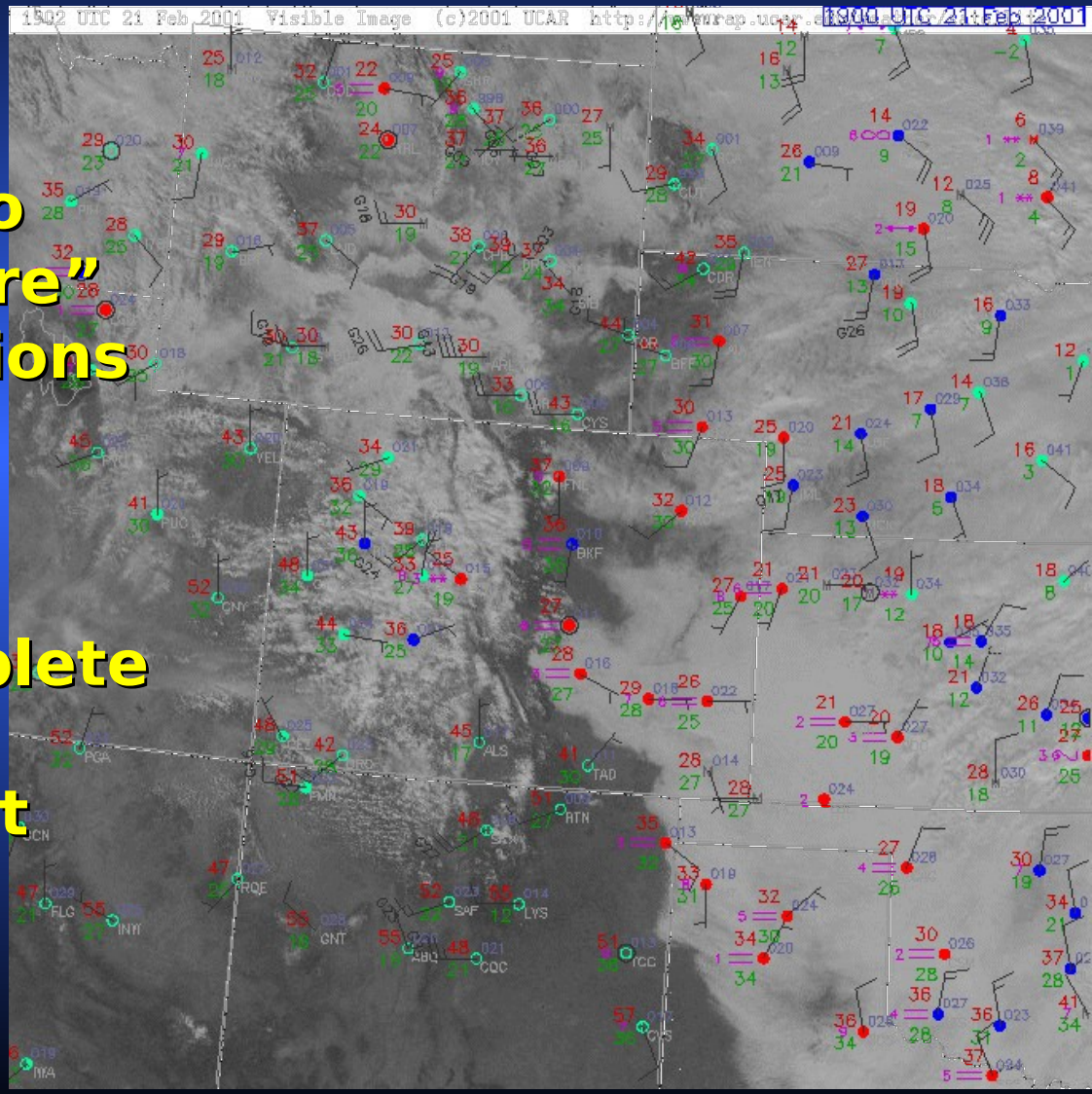
Surface Observations



Connecting dots!

Even dense surface observations can not bring weather data to form a “mental picture” of the current conditions

Only when a satellite image is overlaid on the data does a complete picture of local area weather come to light



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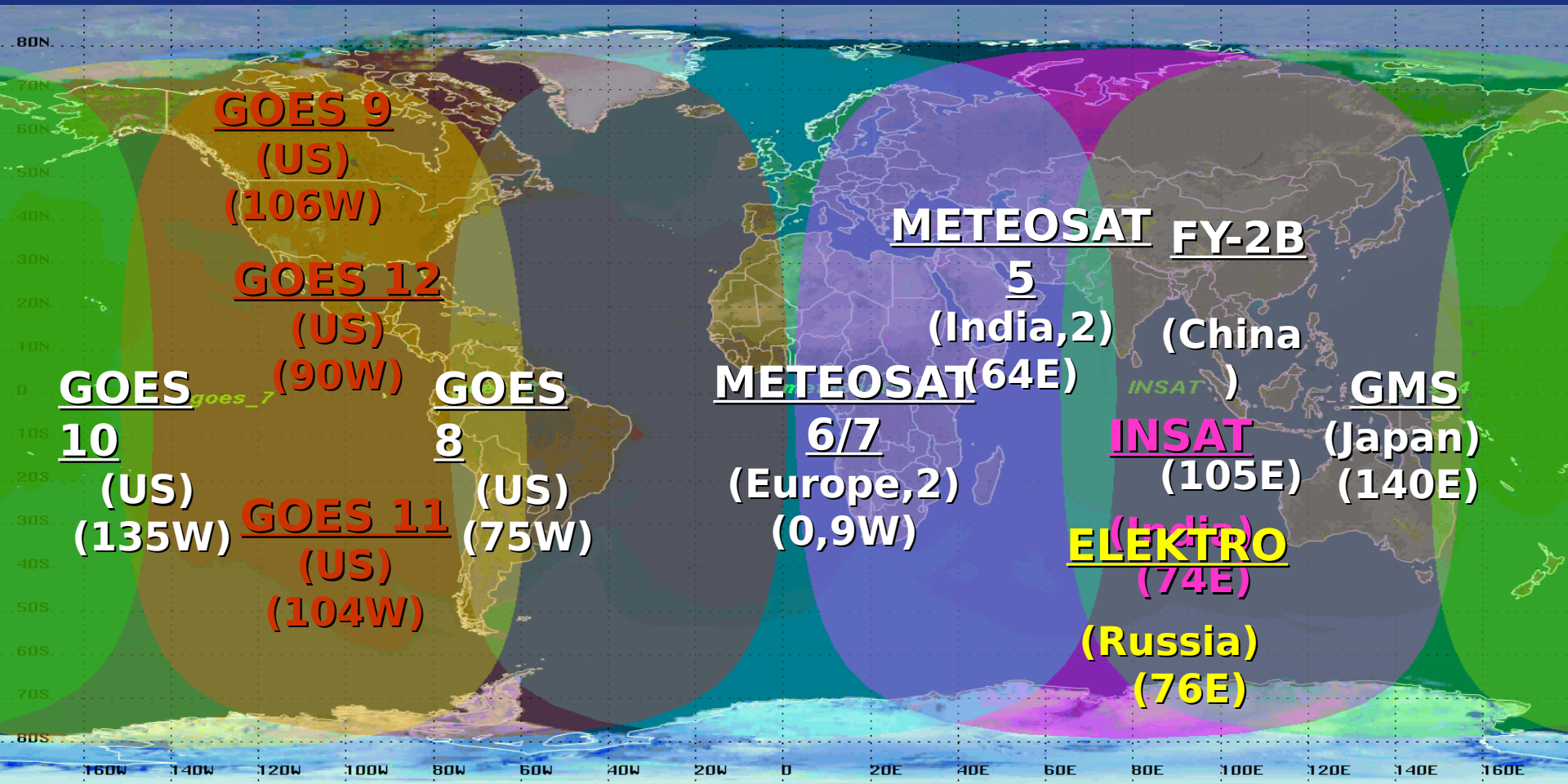
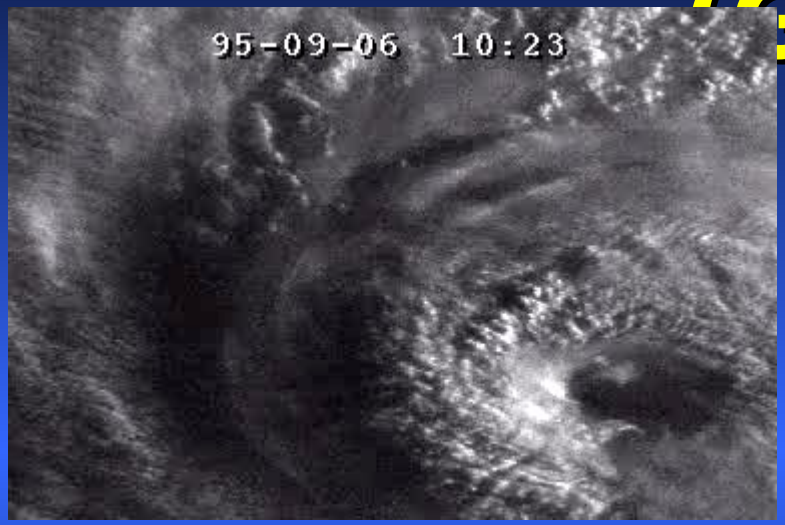
Geostationary Satellite Capabilities

- **Strengths**
  - Rapid refresh (movies versus snapshots)
  - Constant look angle (good frame of reference to gage movements, speed)
  - Excellent “mental image” pictures
- **Weaknesses**
  - Limited high resolution data to tactical
  - Not globally available, share internatio
  - Resolution degrades from satellite sub (nadir)

Geostationary Weather Coverage



Geostationary Operational Environmental Satellite (GOES)



- **Primary Sensors**
  - Imager (Low and High resolution)
    - Visible - 0.8 km
    - IR - 5.7 km
  - Atmospheric Sounder

- **Operated by NOA**

  http://www.noaa.go

- **Refresh rate:**

  25 minutes or less

- **Located at:**

  135 W (10) and 75 W

  105 W (9,11) Storag

Review of Geostationary METSATs

Theater	Satellite	Resolution	Location	Rem
Europe	Meteosat-7	High	0⁰	Encr
		Low	0⁰	
Pacific	GMS	High	140⁰ E	
		Low	140⁰ E	
W Pacific	FY-2B	High	105⁰ E	
Indian	INSAT	High	74⁰ E	Encrypted
	GOMS	Low	76⁰ E	
	Meteosat-5	High	63⁰ E	3 ho
E Americas	GOES-8	High	75⁰ W	
		Low	75⁰ W	
W Americas	GOES-10	High	135⁰ W	
		Low	135⁰ W	

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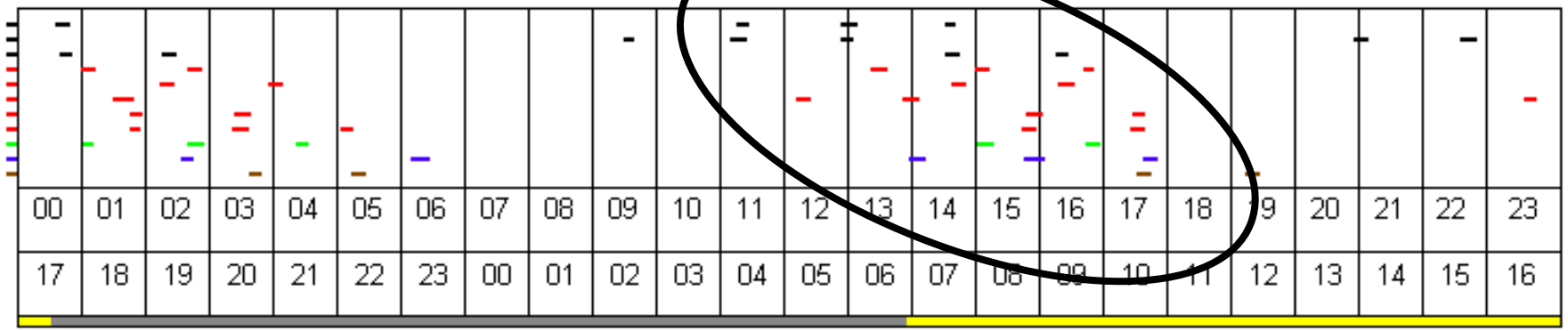
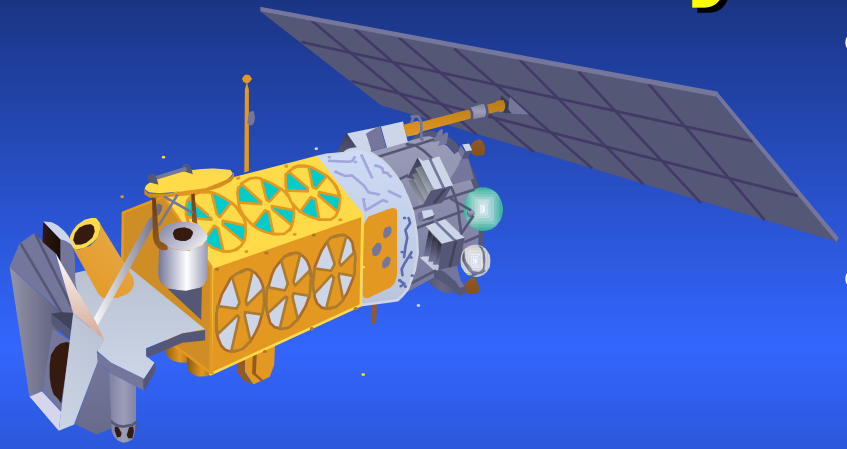
ne Day's Polar Orbiting Satellite Coverage for 11 Satellites



Most polar orbiting METSATs are morning passes and frequently the orbit planes are over populat leaving large gaps in coverage in the early after

US Defense Meteorological Satellite Program (our only military METSAT)



Name	Launched	Sat Cat #	
F15	12 Dec 99	25991	Primary
F14	4 Apr 97	24753	Secondary
F13	24 Mar 95	23533	Primary
F12	29 Aug 94	23233	Secondary

49 satellites since first successful launch on 23 Aug 1962!

- Collect global environmental data
- Provide support to worldwide DOD operations and high priority programs
- Deliver data to strategic and tactical customers

DMSP Satellite Constellation

- **Two-satellite constellation**
- **Sun-synchronous orbit**
  - Near circular orbit
  - Altitude ~ 697 km (450
  - ~ 98.7° inclination
  - 101 minute period
  - 14.2 revs/day

- **Precision LTAN**
  - Satellite passes over the same location at the same local solar time each day
- **Imagery**, soundings and several space environment sensor suites

Types of DMSP Data

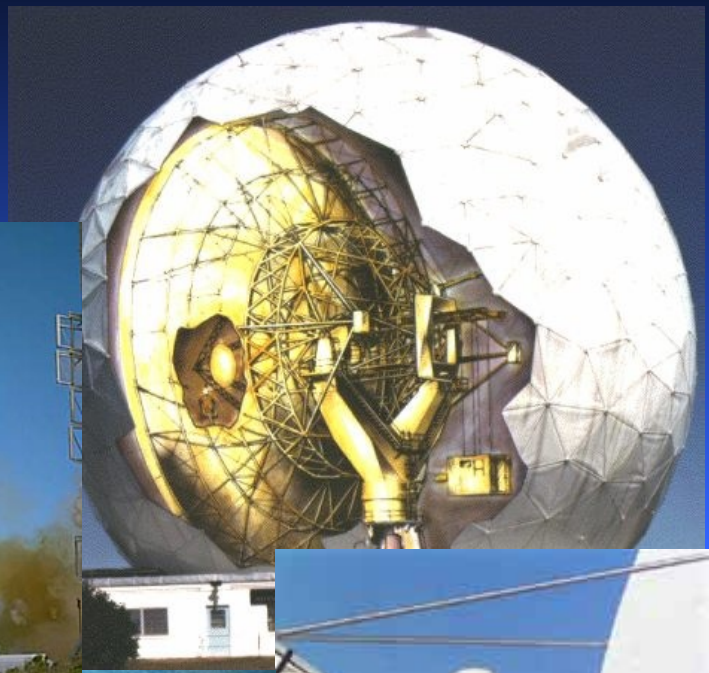
Atmospheric/Surface Data

Cloud Parameters

Sea Ice, Snow Cover
Sea Surface Temperature

Temperature and Moisture Profiles Wind Fields, Ocean Waves
Precipitation, Soil Moistur
Liquid/Solid Water Conten

Land Surface Temperature

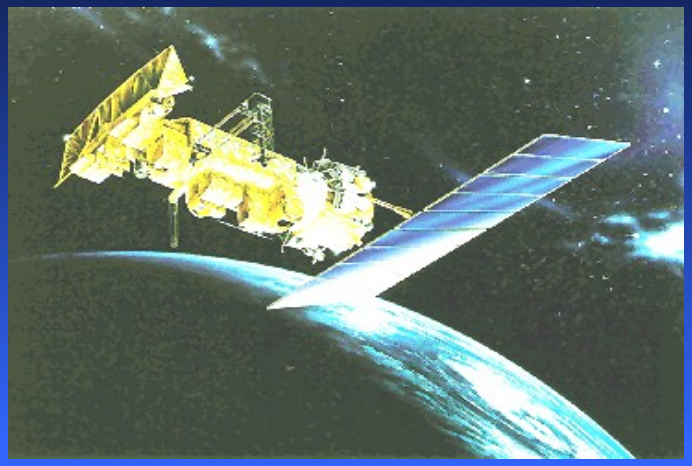


Ionospheric Data

Auroral Emissions & Air Glow

Electron Density Profiles

NOAA POES Satellite Sensors



- **AVHRR** (Advanced Very High Resolution Radiometer) - similar to the DMSP **OLS**
  - Visible and IR imagery (5 Channels, versus 2 for OLS)
  - Two resolutions (HRPT, APT)
    - APT = 4 Km, HRPT = 1 Km
- **TOVS** (TIROS Operational Vertical Sounder) - similar to DMSP **SSM/I**
  - Microwave imager/sounder
- Space Environment Sensors

POES - Polar-orbiting Operational Environmental Satellite, formerly TIROS
Dates back to the original RCA VIDECON television camera launched on TIROS-1 (1 Apr 1960)
(1st successful Corona, 18 Aug 1960) first DMSP, 23 Aug 1962

More information at
http://www.oso.noaa.gov

Search and Rescue System

- Search and Rescue Satellite Aided Tracking (SARSAT), Joint effort of:
  - US, Canada, France
- COSPAS
  - Russia
- 1979, COSPAS-SARSAT
- NOAA TIROS (406 MHz and 121.5/243 MHz)
- Nadezhda (Russian) (406 MHz and 121.5 MHz)
- Prototype packages on GOES 8 and GOES 9

http://www.sarsat.noaa.gov

Review of Polar Metsats

Satellite	Nationality	Resolution	Remarks
DMSP	US DOD	0.6 Km	Encrypted, Vis
		2.8 Km	Encrypted, Vis/IR
NOAA	US	1.0 Km	5 Channels
		4.0Km	5 Channels
METEOR	Russia	1.0 Km	Visible imagery only
RESURS	Russia	1.0 Km	
OKEAN	CIS	1.3 Km	SAR/IR/Vis over EU
SICH	Ukraine	1.3 Km	SAR/IR/Vis over EU
Feng Yun	China	1.1 Km	10 Channels

METSAT Convergence

- Presidential directive, dated 10 May 94
- Combine military and civil METSAT polar orbiting programs to become the National Polar-Orbiting Operational Environmental Satellite System (NPOESS)
- Complete transition by 2009
- Future single satellite design, include a European contribution
- Integrated Program Office (civil and military)

http://www.ipo.noaa.gov

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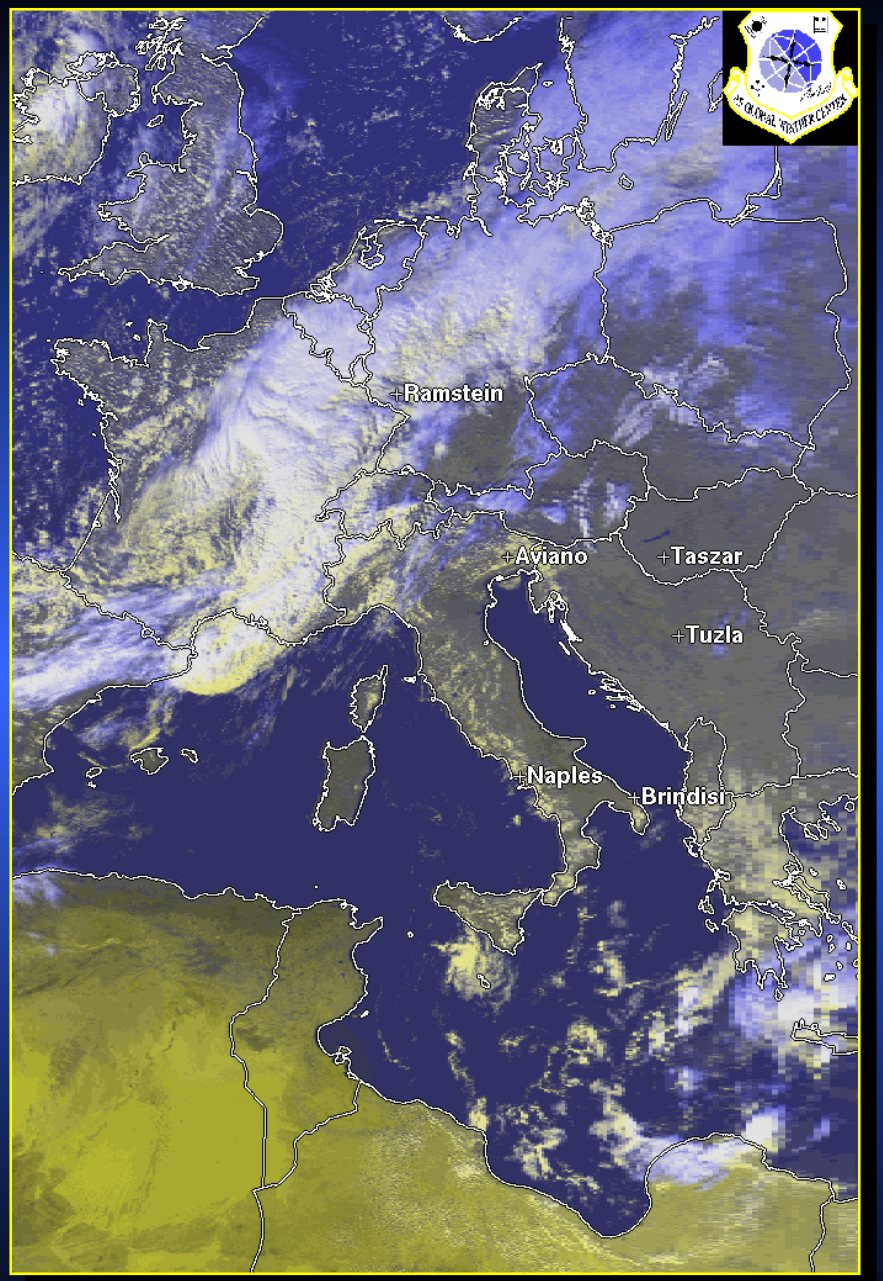
- Ground Systems and Communications
  - Recorded data for strategic users
  - Direct down link for in theater use



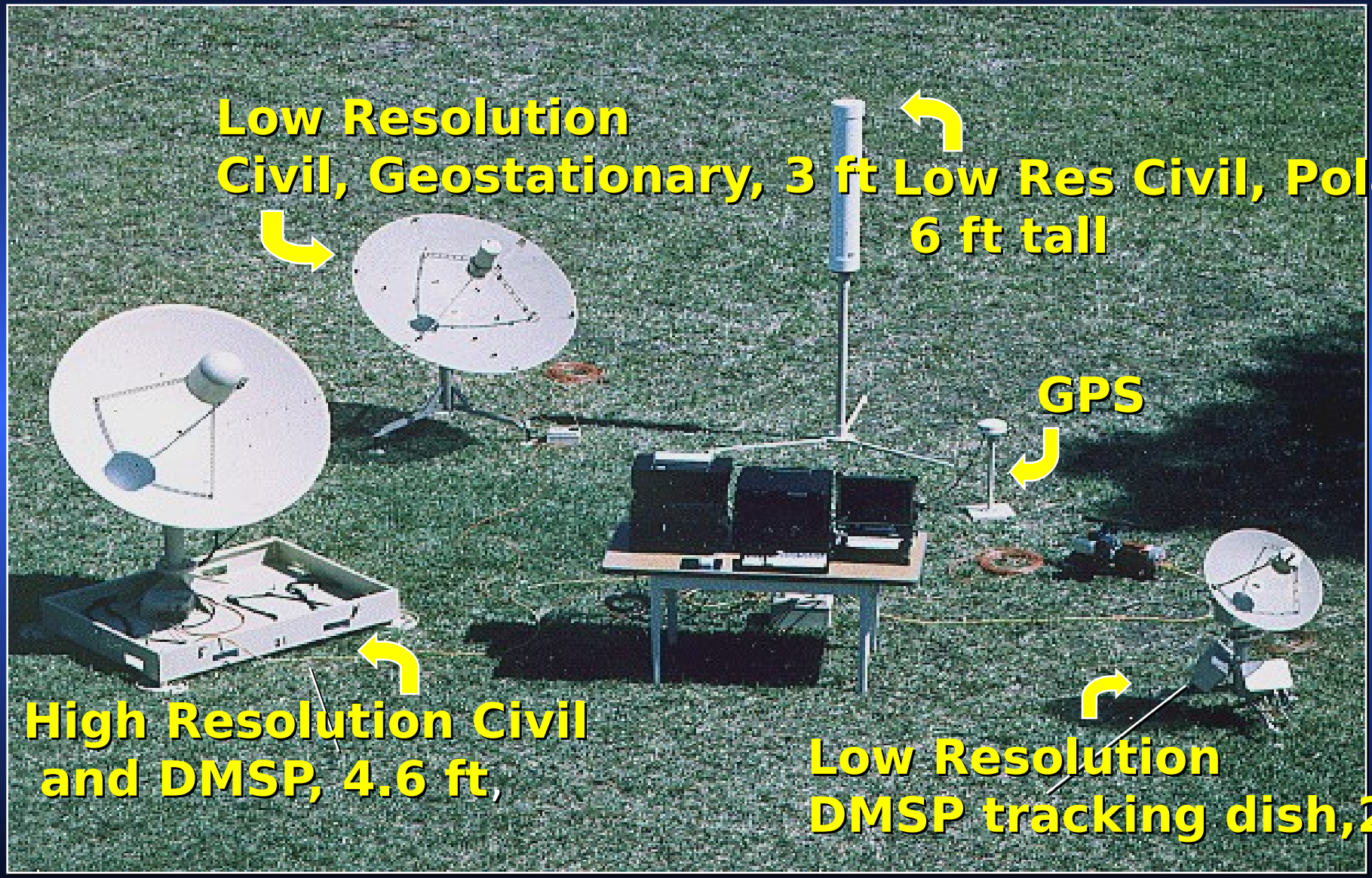
Tactical Users

- Regional coverage
- Near-real-time
- Data not available from all mission sensors
- Customers are land & ship-based units
- DMSP data encrypted
- Prior coordination with AFWA required for low resolution (RDS) DMSP transmission

Tactical Receiver Terminals

- **Theater Level (fixed sites)**
  - AN/SMQ 11, NSDS-E, TESS 3 (Navy)
  - METMF (MSS) (Marines)
  - Mark IVB based at 8 fixed sites
    - Designed for sustainment operations
- **Unit Level (mobile ops)**
  - Small Tactical Terminal (STT)
    - Army/Air Force, 184 units $1/2M each
  - Light weight commercial units for SOF
    - Laptop based $10-20K each (usually no DMSP)

Enhanced STT



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Primary strategic user and distributor of DMSP
data for the Air Force and Army
AFWA products found at Air Force Weather Information Network (AFWIN) web site
http://afwin.afwa.af.mil
(Password required for DMSP) Weather Links

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